

MOLPADIID SEA CUCUMBERS OF CHINA, WITH  
DESCRIPTIONS OF FIVE NEW SPECIES  
(ECHINODERMATA: HOLOTHUROIDEA)

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*Abstract.* — The molpadiid holothurian fauna of China is now known to comprise ten species, of which five, *Caudina atacta*, *C. zhejiangensis*, *Paracaudina delicata*, *Molpadia changi*, and *M. guangdongensis*, are described here as new.

The molpadiid holothurians of China are imperfectly known, and have never been studied as a group. Chang (1934), Chang & Liao (1964), and Liao (1984) recorded five species in their works on the holothurians of China. Over the past 35 years, the shallow coastal waters of China have been investigated by means of shore collecting and offshore benthic sampling. The resulting extensive collection of molpadiid holothurians forms the basis of this paper. In addition, the U.S. Fisheries Commission Steamer *Albatross* collected several molpadiids during its voyages to the Orient in 1907 and 1910.

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Type specimens and other material are deposited at the USNM or at the Institute of Oceanology, Academia Sinica (IOAS), Qingdao, People's Republic of China.

Order MOLPADIIDA Haeckel, 1896

See Mortensen 1927:40; Pawson 1977:98; 1982:818.

*Diagnosis.* — Tentacles 15, digitate; body stout, lacking tube feet, usually with an evident tail; anal papillae, tentacle ampullae and respiratory trees present; ossicles may include tables, cups, fusiform rods or perforated plates, and modified anchors; phosphatic bodies often present.

Key to Families of Molpadiida  
known from China

- 1. Tentacles with a terminal digit and one to three pairs of lateral digits; tail usually evident; ossicles derived from triradiate tables and modified anchors, fusiform rods or perforated plates; phosphatic bodies usually present . . . . . Molpadiidae
- Tentacles without a terminal digit and with one or two pairs of lateral digits; tail sometimes inconspicuous; ossicles large tables, crossed cups, perforated plates or irregular rods; phosphatic bodies usually absent . . . . . Caudinidae

Family Molpadiidae Müller, 1850

See Heding, 1931:277; Pawson, 1977:98; 1982:818.

*Diagnosis.* — See key above.

Genus *Molpadia* Risso, 1826

See Pawson, 1977:99.

*Diagnosis.* — As for the family.

Key to Species of *Molpadia*  
from China

- 1. Anchors and racquet-shaped plates present . . . . *M. roretzi* (v. Marenzeller)
- Anchors and racquet-shaped plates absent . . . . . 2
- 2. Discs of tables incomplete, three-

armed, each arm branching dichotomously; spires smooth, without teeth on pillars . . . . .

. . . . . *M. guangdongensis*, n. sp.

– Discs of tables complete, triangular to circular in outline, spires with two or three teeth on pillars . . . . .

. . . . . *M. changi*, n. sp.

*Molpadia roretzi* (v. Marenzeller)

*Haplodactyla roretzi* v. Marenzeller, 1877: 29, pl. 4, fig. 1.

*Ankyroderma roretzi*. — v. Marenzeller, 1881:124–126, pl. 4, fig. 4. — Théel, 1886: 49. — Mitsukuri, 1912:267, pl. 8, fig. 78, textfig. 55.

*Ankyroderma simile* Théel, 1886:40–41, pl. 2, fig. 5, pl. 11, fig. 2.

*Molpadia similis*. — H. L. Clark, 1907:163, pl. 10, fig. 6.

*Molpadia roretzi*. — H. L. Clark, 1907:163. — Ohshima, 1915:249. — Chang, 1934:23, textfigs. 11–12, pl. 3, fig. 1. — Chang & Liao, 1964:44.

*Molpadia chinensis* Chang, 1934:26, textfig. 13–14, pl. 3, fig. 2.

*Material examined*. — Numerous specimens from Yellow Sea, East China Sea and South China Sea, in depths of 44–200 m. In USNM, *Albatross* Station 5194, 11°15'N, 124°11'E, 271 m, 1 specimen.

*Diagnosis*. — Large to medium-sized, up to 120 mm long; phosphatic bodies abundant, imparting reddish brown or purple color to body wall; ossicles include anchors and racquet-shaped bodies, and scattered tables of varying shape, usually with a circular disc, 60–70  $\mu$ m in diameter.

*Remarks*. — This is apparently the most common *Molpadia* in China, especially in the Yellow Sea and East China Sea. There are over 100 specimens in the IOAS, collected at various stations from the Yellow Sea to the South China Sea in 44–200 m depth. They are 20–100 mm long, with great variation in number and form of the phosphatic bodies and ossicles, and color of body

wall. The smallest specimens are gray, and yellowish-brown dots indicating developing phosphatic bodies are visible only under the microscope. In full-grown specimens, the phosphatic deposits are aggregated; thus, the body wall is dark brown to dark purple.

All of the 17 specimens from the South China Sea in depths of 145–200 m are small, 20–30 mm long; the phosphatic bodies are scarce, and yellowish in color.

*Molpadia chinensis* (Chang 1934) was based upon two specimens that are sympatric with *M. roretzi*. The morphology and body wall ossicles of *M. chinensis* fall within the range of variation of *M. roretzi*, and we believe these species are synonymous.

*Distribution*. — From southern Japan to the South China Sea, southward to the Philippines, in 44–620 m.

*Molpadia changi*, new species

Fig. 1

*Molpadia andamanensis*. — Chang & Liao, 1964:45 [Not *M. andamanensis* (Walsh)].

*Material examined*. — Ninety six specimens. Holotype: IOAS E1007, off Zhejiang Province, 29°N, 122°30'E, 9 Jul 1959, 53 m, muddy bottom. Paratypes: IOAS E1008, same locality as Holotype, 3 specimens; USNM E40415, same locality as Holotype, 3 specimens; IOAS E1010, 33°N, 124°E, 66 m, 2 specimens; IOAS E1011, 29°N, 123°E, 63 m, 5 specimens; IOAS E1012, 29°N, 123°30'E, 81 m, 27 specimens; IOAS E1013, 29°30'N, 123°30'E, 63 m, 1 specimen; IOAS E1014, 29°30'N, 124°E, 69 m, 3 specimens; IOAS E1015, 28°30'N, 122°30'E, 63 m, 10 specimens; IOAS E1016, 28°30'N, 123°30'E, 85 m, 4 specimens; IOAS E1017, 28°30'N, 124°E, 90 m, 1 specimen; IOAS E1018, 29°30'N, 122°45'E, 50 m, 2 specimens; IOAS E1019, 21°45'N, 113°45'E, 35 m, 1 specimen; IOAS E1020, 21°45'N, 114°E, 38 m, 7 specimens; IOAS E1021, 21°N, 112°E, 45 m, 7 specimens; IOAS E1022, 21°N, 113°30'E, 42 m, 7 specimens; IOAS E1023, 20°45'N, 111°30'E, 47 m, 4 specimens; IOAS

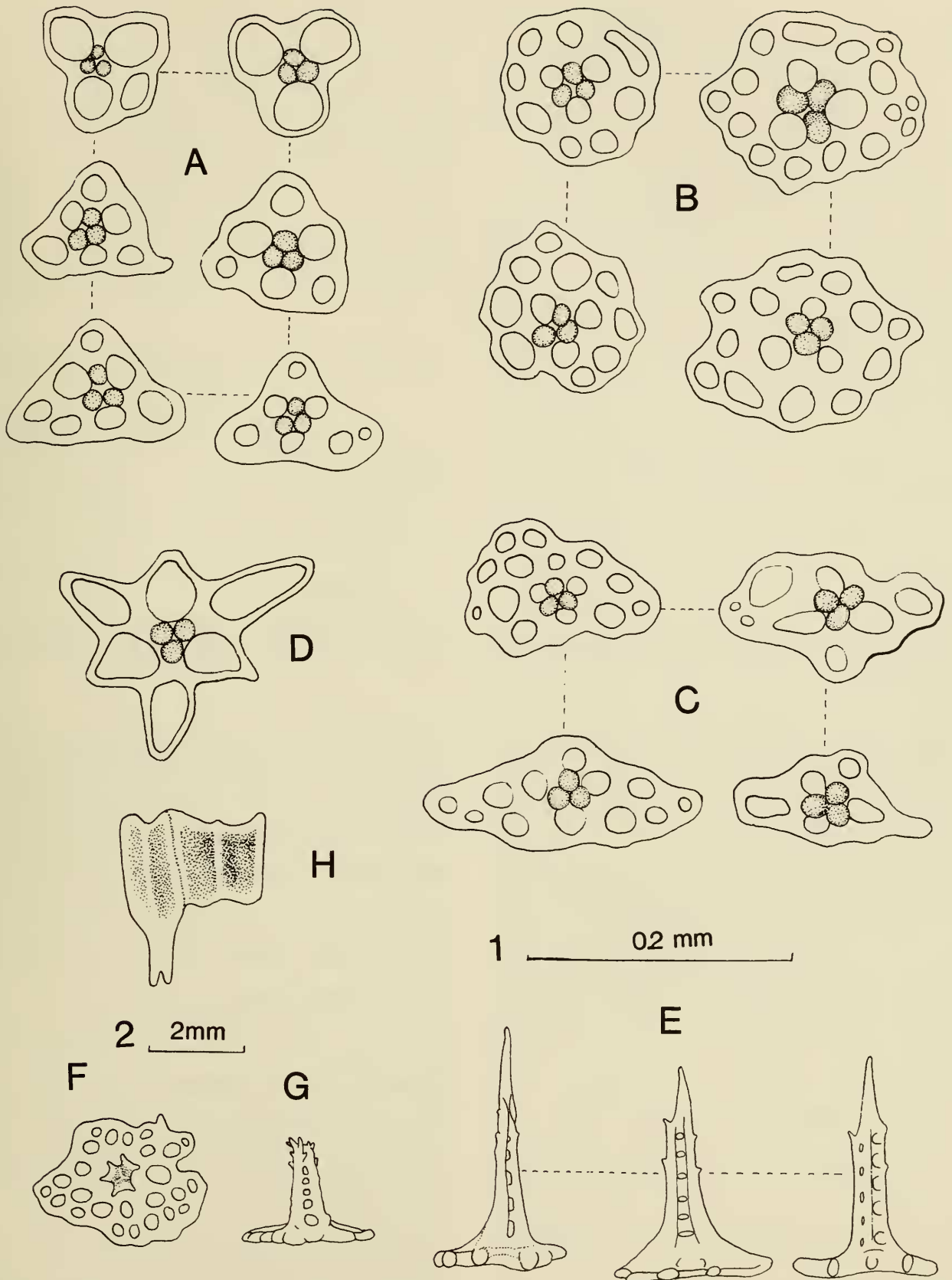


Fig. 1. *Molpadia changi*, new species. A, triangular tables from body wall; B, circular tables from body wall; C, elongate oval tables from body wall; D, delicate table from body wall; E, body wall tables in profile; F, table from tail; G, table from tail in profile; H, radial and interradial pieces of calcareous ring.

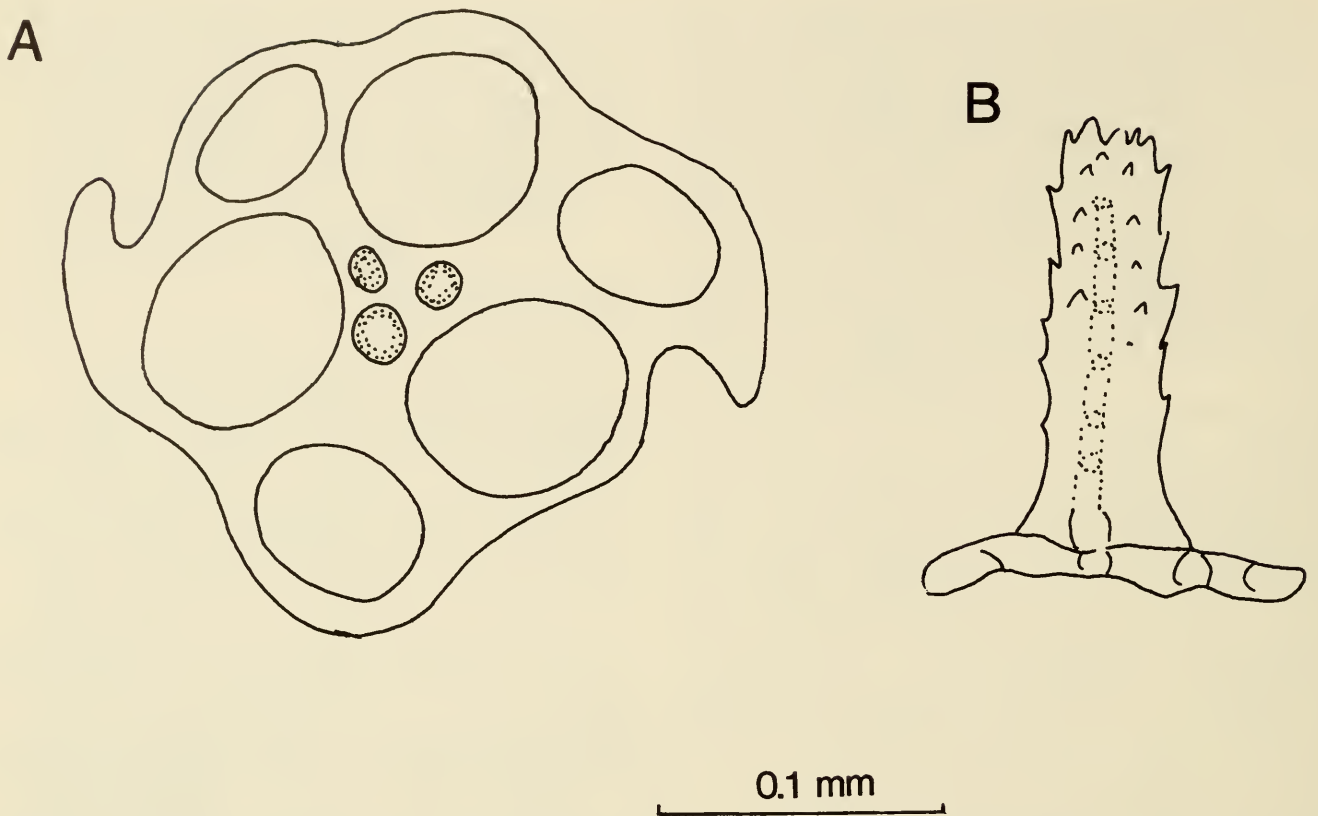


Fig. 2. *Molpadia andamanensis* (Walsh) from Indian Ocean. A, table from body wall; B, table from body wall in profile.

E1024, 22°N, 114°30'E, 46 m, 4 specimens; IOAS E1025, 21°45'N, 112°30'E, 41 m, 4 specimens; IOAS E1026, 20°N, 111°45'E, 44 m, 1 specimen.

*Diagnosis.*—Medium-sized to large, largest specimen 120 mm long. Phosphatic bodies present. Ossicles in body wall and tail exclusively tables, the discs circular to triangular, with undulating margin and 3–16 perforations; spires high, composed of three pillars joined by 5 or 6 crossbars, pillars fused distally to form a single point. Outer surface of spire carries 2 or 3 teeth.

*Description.*—Holotype total length 85 mm, diameter 28 mm, tail 20 mm; largest Paratype 120 mm long, 48 mm diameter. Body of typical molpadiid shape. Tentacles with a pair of minute digits. Anus surrounded by 5 groups of minute papillae. Body wall thin, delicate, slightly rough to touch. Calcareous ring with sculptured surface; radial pieces with short bifurcate posterior projections (Fig. 1H). Stone canal and Polian vesicle single. Color in alcohol light brown, tail whitish.

Ossicles exclusively tables (Fig. 1A–E), discs 100–160  $\mu\text{m}$  in diameter, circular to triangular in outline, with undulating margin; 3–16 perforations in disc. Spires high (averaging 160  $\mu\text{m}$ ), composed of 3 pillars joined by 5 or 6 crossbars; pillars fuse distally to form a single projection. Outer surface of spire carries 2 or 3 teeth. More delicate tables, averaging 150  $\mu\text{m}$  in diameter, often with approximately 6 perforations, are also scattered in the body wall. Phosphatic deposits present, scattered. Tail with tables (Fig. 1F, G) lower and smaller than those described above; disc with numerous small perforations, and short spires with several terminal teeth.

*Remarks.*—This new species has been confused with *Molpadia andamanensis* (Walsh), an East Indies and Indian Ocean species with a bathymetric range of 310–1210 m. Chang & Liao (1964) reported *M. andamanensis* from 35–90 m off China, but this material was, in fact, *M. changi*. Examination of specimens of *M. andamanensis* in the USNM enables us to confirm that

Chinese specimens do indeed represent a different species. In *M. changi*, the tables are 100–160  $\mu\text{m}$  in diameter, with spires terminating in a single point, while in *M. andamanensis* the tables are 200–280  $\mu\text{m}$  in diameter, with spires terminating in numerous teeth (Fig. 2A–B).

*Distribution.*—From the Yellow Sea (33°N, 124°E) to the Philippines (11°38'N, 124°40'E), in 35–90 m.

*Molpadia guangdongensis*, new species  
Fig. 3

*Material examined.*—Twenty six specimens. Holotype: IOAS E1009, off the east coast of Hainan Island, 19°N, 111°30'E, 19 Oct 1959, 144 m. Paratypes: IOAS E1027, same locality as Holotype, 3 specimens; IOAS E1028, 17°45'N, 110°30'E, 200 m, 5 specimens; IOAS E1029, 18°N, 110°30'E, 000 m, 3 specimens; IOAS E1030, 22°116'E, 89 m, 1 specimen; IOAS E1031, 18°45'N, 111°E, 122 m, 1 specimen; IOAS E1032, 17°30'N, 110°E, 140 m, 3 specimens; IOAS E1033, 21°45'N, 115°30'E, 105 m, 3 specimens; IOAS E1034, 18°15'N, 110°30'E, 125 m, 1 specimen; IOAS E1035, 17°N, 109°30'E, 121 m, 1 specimen; IOAS E1036, 17°N, 109°30'E, 115 m, 1 specimen; IOAS E1037, 18°30'N, 111°E, 151 m, 1 specimen; USNM E40417, *Albatross* Sta. 5308, 21°54'N, 115°42'E, 113 m, 2 specimens.

*Diagnosis.*—Small form, 30–40 mm long. Phosphatic bodies absent, but outer body wall may be discolored. Ossicles exclusively tables with high smooth spires composed of 3 pillars joined by 8–9 crossbars; the pillars fused distally to form a single point. Discs of tables variable in shape, usually incomplete, with three dichotomised arms; disc may be complete, triangular, oval to irregular in outline, with 2–6 perforations.

*Description.*—Holotype total length 40 mm, diameter 15 mm, tail 3 mm. Body barrel-shaped, with very short tail. Calcareous ring with sculptured surface; radial pieces with short bifurcate posterior projections (Fig. 3H). Anus surrounded by 5 groups

of papillae. Stone canal and Polian vesicle single. Body wall thin and rough to touch, due to presence of numerous ossicles with long spires. Color in alcohol grayish-white.

Ossicles exclusively tables (Fig. 3A–E) with high (averaging 200  $\mu\text{m}$ ) smooth spires composed of 3 pillars joined by 8–9 crossbars; distally the 3 pillars fuse to form a single projection, which rarely carries 2 or 3 recurved spines. Discs of tables 120–260  $\mu\text{m}$  in diameter, greatly variable in shape, usually composed of three dichotomously branched arms, with extremities of the arms straight or only slightly curved. Sometimes table discs complete, oval to triangular, with 2–6 perforations. Tables in tail (Fig. 3F, G) fusiform rods, 220–270  $\mu\text{m}$  long, with low spires and four central perforations.

*Remarks.*—This new species resembles *Trochostoma parvulum* Cherbonnier & Feral, 1981, from the Philippines, but it differs in that the 6 branches of the three-armed tables are not strongly curved; also, the distal extremities of the spires are fused to form a single point. Further, in their description of *T. parvulum*, Cherbonnier & Feral mention “Les uns, tres nombreux, caracteristiques de l'espece sont en forme d'un X dont les branches ont les extremités condees (fig. 28,A).” We have found no such X-shaped bodies in *Molpadia guangdongensis*.

*Distribution.*—South China Sea, from 17°N, 109°30'E, to 22°N, 116°E, in 89–200 m.

Family Caudinidae Heding, 1931

See Heding, 1931:282; Pawson, 1977:119; 1982:818.

*Diagnosis.*—See key above.

Key to genera of Family Caudinidae  
from China

1. Tentacles with 2 pairs of lateral digits; tail usually long and slender ..... 2
- Tentacles without digits or with only

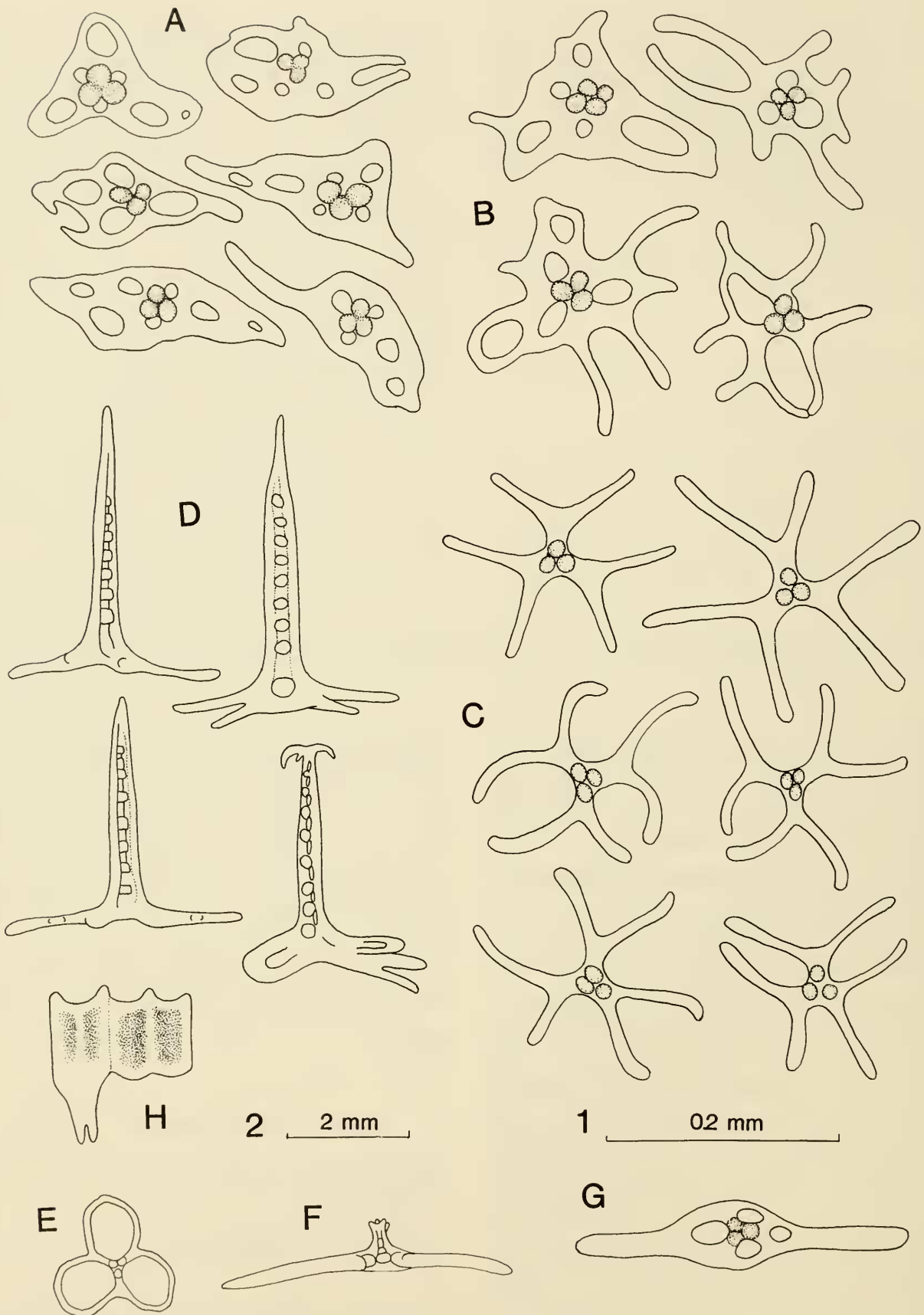


Fig. 3. *Molpadia guangdongensis*, new species. Elongate and rhomboid tables from body wall; B, irregular tables from body wall; C, tables from body wall with disc composed of 3 bifurcate arms; D, tables from body wall in profile; E, delicate table from body wall; F, table from tail in profile; G, table from tail; H, radial and interradial pieces of calcareous ring.

one pair of lateral digits; tail absent or inconspicuous . . . . . *Acaudina*

- 2. Ossicles small cups, perforated plates, or irregular rods . . *Paracaudina*
- Ossicles large tables, and knobbed buttons or perforated plates . . *Caudina*

Genus *Caudina* Stimpson, 1853

See Deichmann, 1938:112; 1940:211.

*Diagnosis.*—Tentacles with 2 pairs of digits, the distal pair longer, but no terminal digit. Body barrel-shaped with a short or long tail. Radial pieces of calcareous ring with short posterior projections. Ossicles large tables, usually with a spire of 4 short pillars, terminating in a few teeth; knobbed buttons or irregular perforated plates also present.

Key to known species of *Caudina*

- 1. Tables inconspicuous, scarce, reduced to rods or plates, or lacking . . . . . *arenicola* (Stimpson, 1853)
- Tables conspicuous, numerous, with well-developed spire and disk . . . . . 2
- 2. Tables accompanied by knobbed buttons . . . . . 3
- Tables accompanied by perforated plates . . . . . 4
- 3. Buttons not abundant, weakly knobbed, usually oval in outline, with two large elliptical and two small circular holes . . . . . *arenata* Gould, 1841
- Buttons abundant, strongly knobbed, usually with irregular outline, the four holes more or less alike in size and form . . . . . *similis* (Augustin, 1908)
- 4. Discs of tables 180–280  $\mu\text{m}$  in diameter; perforated plates very variable in form and in number of holes, lacking knobs . . . . . *atacta*, n. sp.
- Discs of tables 150–180  $\mu\text{m}$  in diameter; perforated plates vary only slightly in form and in number of holes, often possessing a few low knobs . . . . . *zhejiangensis*, n. sp.

*Caudina similis* (Augustin)

Fig. 4

*Trochostoma simile* Augustin, 1908:38, pl. 2, fig. 7, textfig. 25.

*Caudina similis.*—Heding, 1931:283.—H. L. Clark, 1935:278.—Deichmann, 1938:112.

*Material examined.*—Twenty specimens. IOAS E1038, 33°N, 123°E, 36 m, 1 specimen; IOAS E1039, 33°15'N, 123°30'E, 46 m, 1 specimen; IOAS E1040, 33°N, 124°E, 66 m, 15 specimens; IOAS E1041, 33°30'N, 123°E, 48 m, 3 specimens.

*Diagnosis.*—Medium-sized form up to 60 mm long; ossicles well-developed tables, discs circular to square with undulated margin and 10–16 holes arranged around a central opening, the spires of moderate height, solid, ending in 3 or 4 spines. Buttons regular or irregular in outline, strongly knobbed, with a varying number of holes.

*Description.*—Total length 40–60 mm, diameter 13–15 mm, tail about 30% of body length. Body fusiform, gradually tapering posteriorly into a narrow tail. Stone canal and Polian vesicle single. Radial pieces of calcareous ring with a short bifid posterior projection (Fig. 4G). Body wall firm, coriaceous, rough to touch. Color in alcohol yellowish-white.

Ossicles closely crowded tables and buttons. Tables (Fig. 4A, B) with circular to square discs 80–130  $\mu\text{m}$  in diameter, slightly undulating margin, with 10–16 perforations surrounding a central opening; spires moderate, 60–80  $\mu\text{m}$  high, solid, ending in four spines. Buttons (Fig. 4C, D) regular (80–90  $\mu\text{m}$  long, 60–70  $\mu\text{m}$  wide) to irregular (80–120  $\mu\text{m}$  in diameter) in outline, strongly knobbed, with varying number of holes. In tail, tables (Fig. 4E, F) smaller, with distinct knobs on discs.

*Remarks.*—This species was based (Augustin 1908) on 4 specimens from southern Japan in 100–300 m, and apparently it has not been collected since. Study of material of *Caudina arenata* (Gould) in the USNM

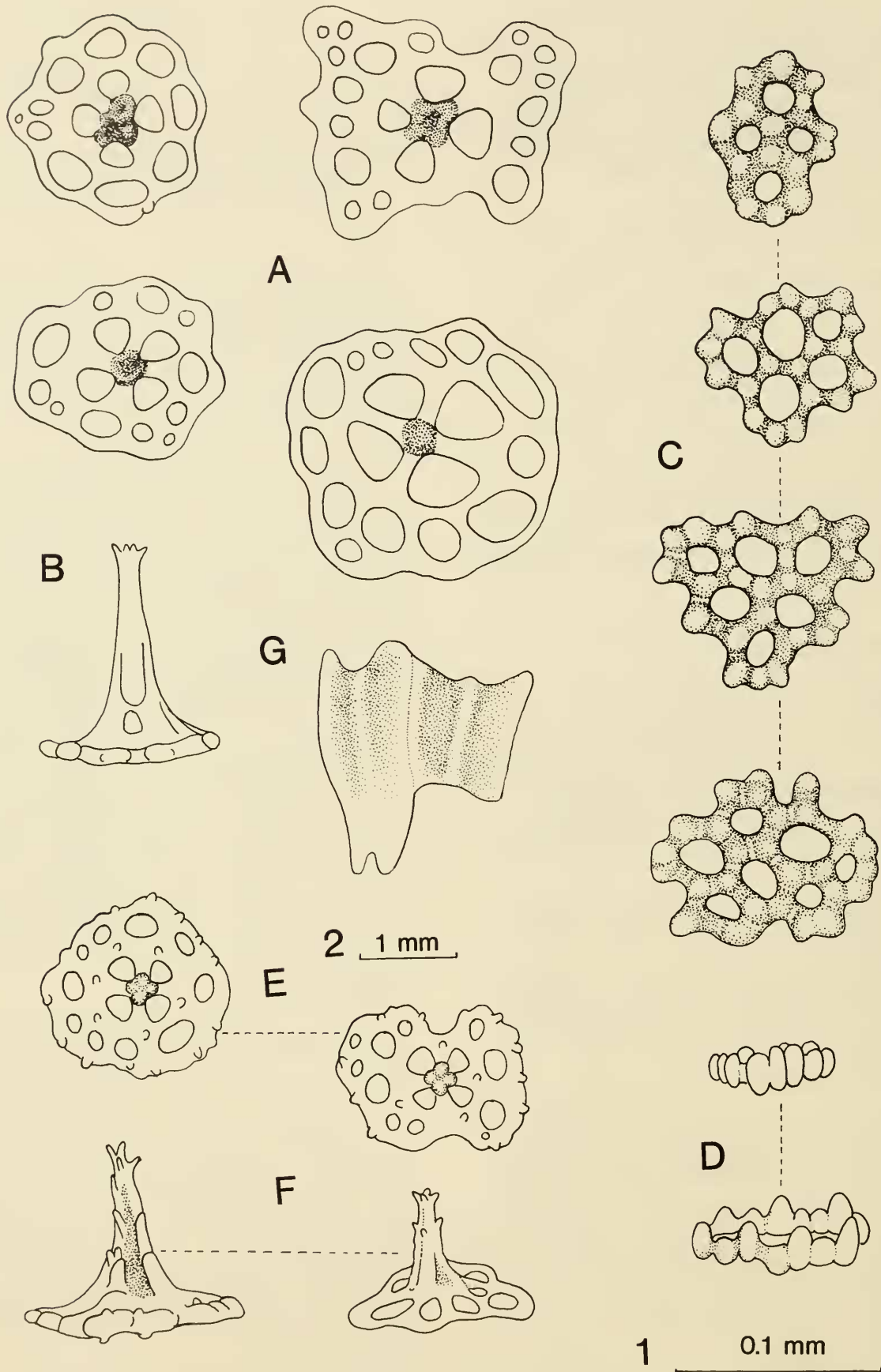


Fig. 4. *Caudina similis* (Augustin). A, tables from body wall; B, table from body wall in profile; C, irregular knobbed buttons; D, knobbed buttons in profile; E, tables from tail; F, tables from tail in profile; G, radial and interradial pieces of calcareous ring.



shows that these two species are undoubtedly closely related.

*Distribution.*—Known only from Sagami Bay, Japan, and the Yellow Sea, China, in 36–300 m.

*Caudina atacta*, new species

Fig. 5

*Material examined.*—Ten specimens. Holotype: IOAS E1005, Gulf of Tonkin, 17°45'N, 107°45'E, 13 Feb 1960, 80 m. Paratypes: IOAS E1042, same locality as Holotype, 2 specimens; USNM E40418, same locality as Holotype, 1 specimen; IOAS E1043, 18°30'N, 108°30'E, 63 m, 2 specimens; IOAS E1044, 19°N, 108°E, 73 m, 1 specimen; IOAS E1045, 18°30'N, 108°E, 69 m, 1 specimen; IOAS E1046, 18°30'N, 107°30'E, 72 m, 1 specimen; IOAS E1047, 17°30'N, 107°30'E, 91 m, 1 specimen.

*Diagnosis.*—Small form, largest 53 mm long. Ossicles large and stout tables, discs irregular in outline, with varying number of perforations; spires four-pillared, of low to moderate height, ending in 3 blunt teeth or in a single blunt point. Numerous perforated plates also present, with varying number of perforations, and frequently with one or more handle-like marginal projections.

*Description.*—Total length of Holotype 53 mm, diameter 20 mm, tail 24 mm long. Body barrel-shaped, with long and narrow tail. Anus not distinctly papillate. Body wall thick and rough to touch, due to presence of numerous ossicles. Short posterior projections on radial pieces of calcareous ring (Fig. 5F). Stone canal and Polian vesicle single. Color in alcohol whitish.

Ossicles numerous large and stout tables (Fig. 5A–C) 180–280  $\mu$ m in diameter, discs thick, very variable in outline, with varying number of perforations. Spires low, 80–100  $\mu$ m high, four-pillared, ending in 3 blunt teeth or in a single solid point. Plates (Fig. 5D) very numerous 160–220  $\mu$ m long and 80–180  $\mu$ m wide, very variable in shape and in number of perforations, usually with han-

dle-like projection on margin. Tail with smaller tables (Fig. 5E), with more numerous perforations and with edge of disc slightly knobbed. No phosphatic bodies.

*Remarks.*—According to Deichmann (1938), members of the genus *Caudina* in the strict sense are *C. arenata* Gould from the eastern United States, *C. similis* (Augustin) from Japan, and *C. arenicola* (Stimpson) from southern California. *Caudina atacta* differs from the first two species in lacking knobbed buttons from the body wall, and *C. arenicola* usually lacks body wall ossicles, or they are reduced to rods and small plates.

*Distribution.*—Known only from the Gulf of Tonkin, ranging from 17°30'N, 107°30'E to 19°N, 108°E, in 63–91 m.

*Caudina zhejiangensis*, new species

Fig. 6

*Material examined.*—Twenty five specimens. Holotype: IOAS E1006, off Zhejiang Province, East China Sea, 29°N, 123°E, 3 Apr 1959, 65 m, muddy bottom. Paratypes: IOAS E1048, same locality as Holotype, 3 specimens; USNM E42003, same locality as Holotype, 9 July 1959, 68 m, 4 specimens; IOAS E1049, 29°30'N, 123°30'E, 53 m, 4 specimens; IOAS E1050, 29°30'N, 123°E, 61 m, 1 specimen; IOAS E1051, 28°30'N, 123°E, 78 m, 1 specimen; IOAS E1052, 28°30'N, 124°E, 89 m, 2 specimens; IOAS E1053, 28°30'N, 122°30'E, 63 m, 1 specimen; IOAS E1054, 28°N, 122°30'E, 79 m, 1 specimen; IOAS E1055, vicinity of Zhou-Shan Archipelago, 60 m, 8 specimens.

*Diagnosis.*—Small form up to 35 mm long. Numerous ossicles in form of tables, with circular to square discs; central hole surrounded by a simple single or double ring of 8 or 16 perforations; spires four-pillared, ending in three short teeth or a single conical projection. Numerous irregular perforated plates also present, usually with 4–12 perforations, and a few low knobs. Tail with

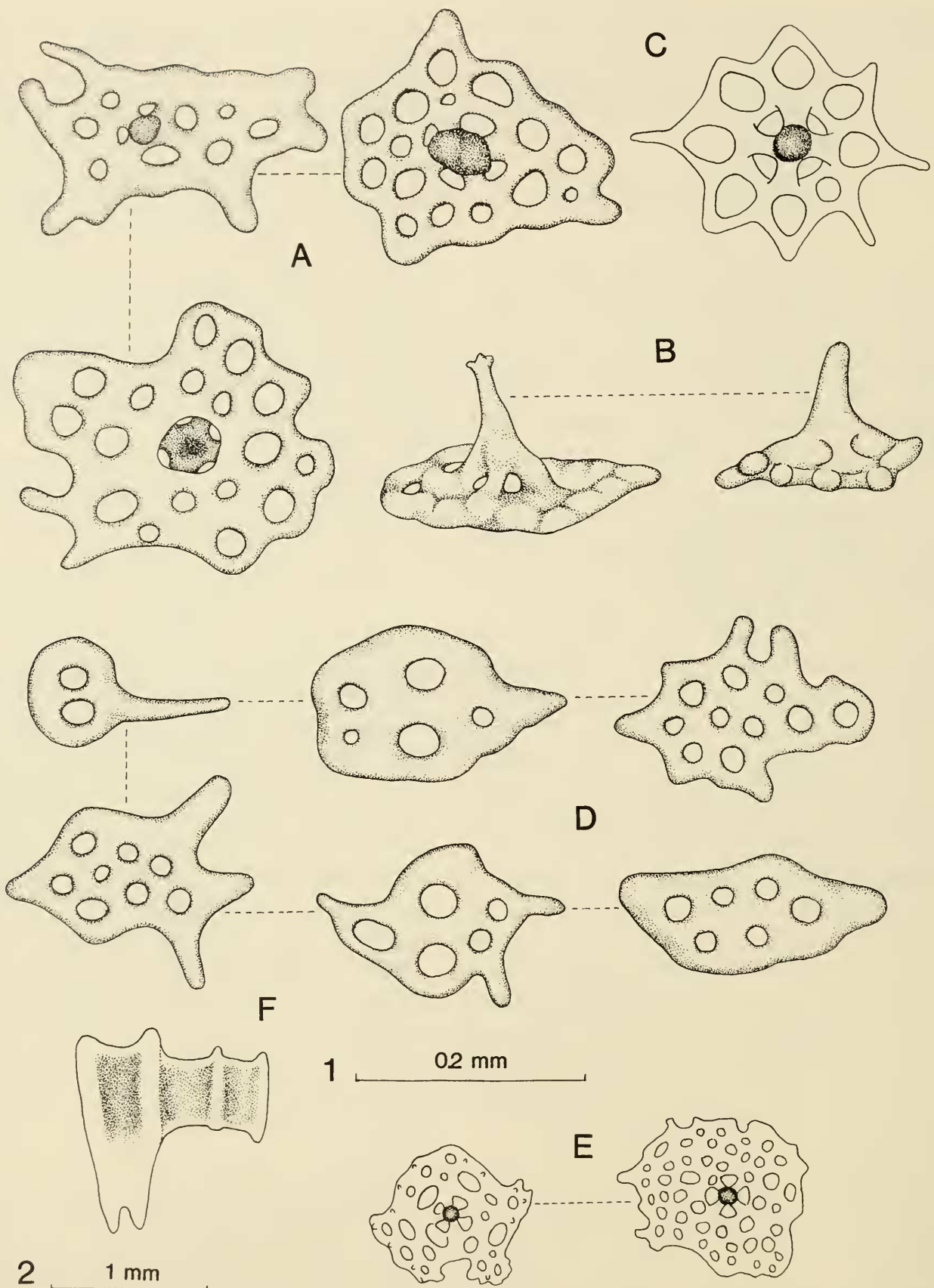


Fig. 5. *Caudina atacta*, new species. A, tables from body wall; B, tables from body wall in profile; C, delicate table from body wall; D, plates from body wall; E, tables from tail; F, radial and interradial pieces of the calcareous ring.

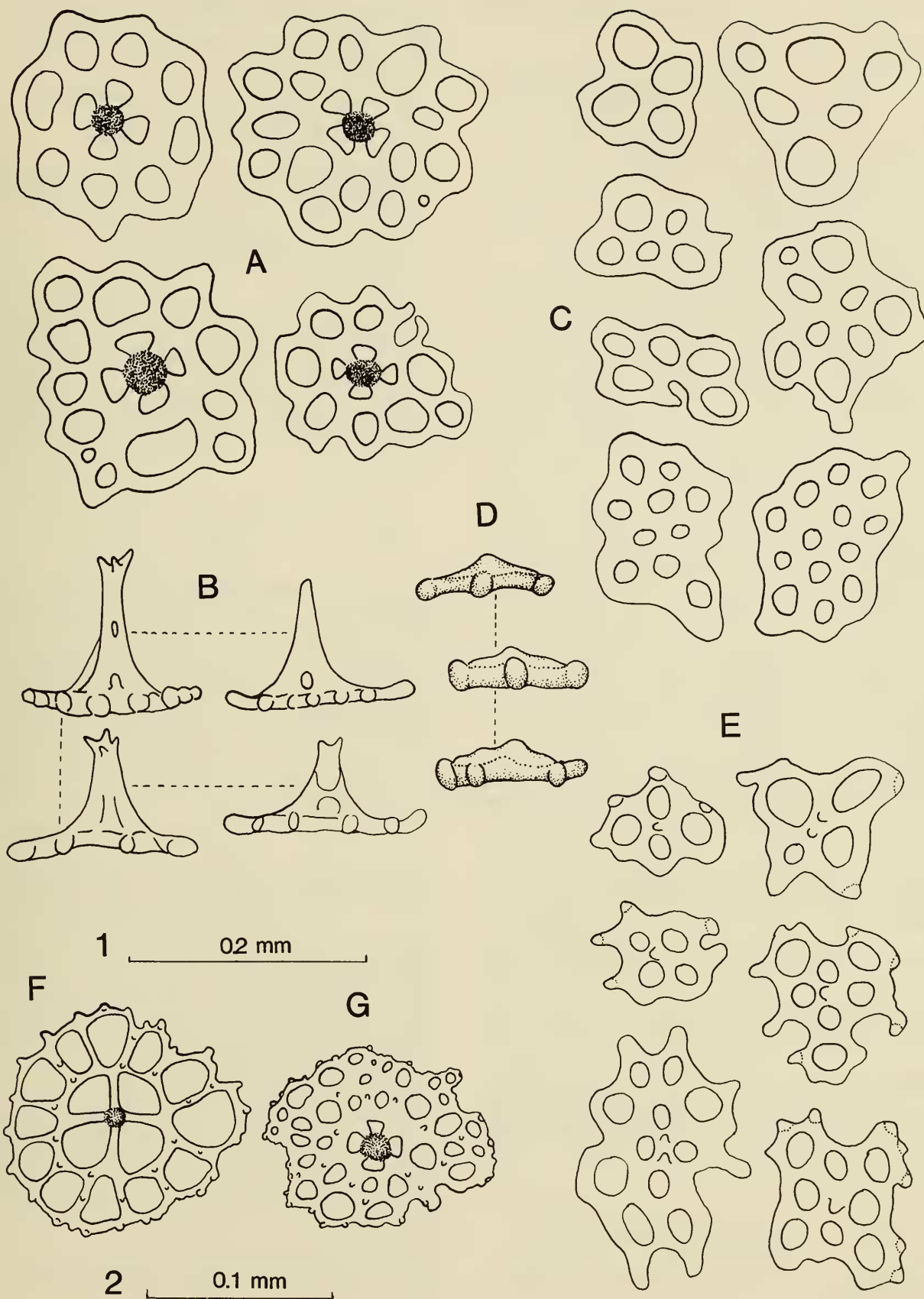


Fig. 6. *Caudina zhejiangensis*, new species. A, tables from body wall; B, tables from body wall in profile; C, irregularly perforated plates from body wall; D, knobbed perforated plates from body wall in profile view; E, knobbed perforated plates from body wall; F, delicate table from body wall; G, table from tail.



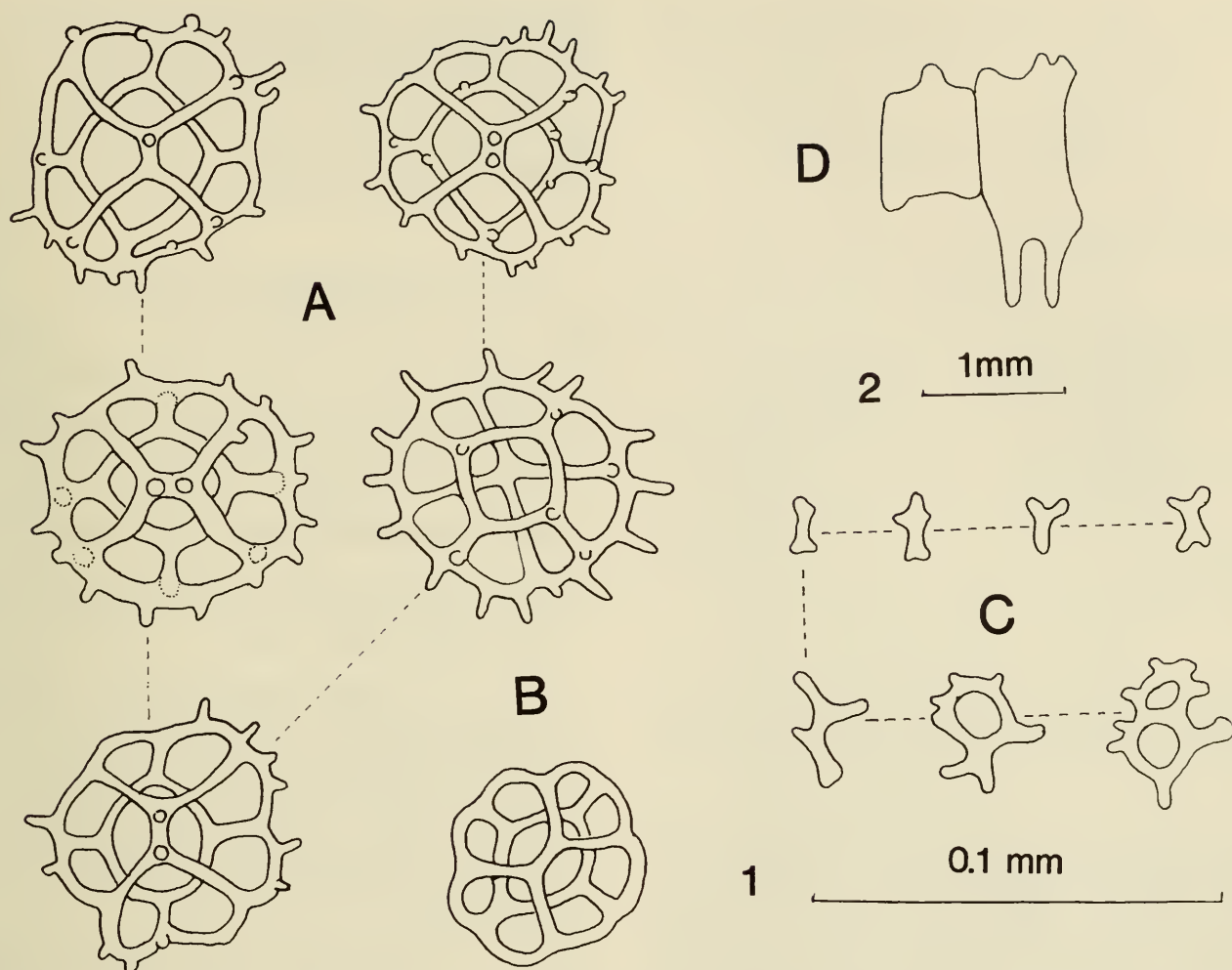


Fig. 7. *Paracaudina delicata*, new species. A, crossed cups from body wall; B, crossed cups with smooth edge; C, ossicles from anal projections; D, radial and interradial pieces of calcareous ring.

projections present, in form of minute irregular rods and plates (Fig. 7C).

*Remarks.*—*Paracaudina delicata* is unique in having delicate crossed cups with fine projections around the margin. Small individuals of *Paracaudina chilensis* have crossed cups of similar basic structure (Hozawa 1928, Pawson 1963), but they differ in several details (see Figs. 7A, 8).

*Distribution.*—Known only from a single specimen from the Gulf of Tonkin, at a depth of 21 m.

*Paracaudina chilensis* (Müller)

Fig. 8

*Molpadia chilensis* Müller, 1850:139.

*Caudina ransonnetii* von Marenzeller, 1881:126.

*Caudina chilensis.*—Hozawa, 1928:361, pls.

14–17.—Chang, 1934:29, pl. 3, fig. 3, textfig. 15.—Yang, 1937:22, pl. 4, fig. 3, textfig 13.

*Pseudocaudina ransonnetii.*—Heding, 1931:283.

*Paracaudina ransonnetii.*—Heding, 1932:455.

*Paracaudina chilensis* var. *ransonnetii.*—H. L. Clark, 1935:281; 1938:540; 1946:444.—Chang & Liao, 1964:45.

*Paracaudina chilensis.*—Pawson, 1963:10; 1970:49, pl. 2, fig. 2.—A. M. Clark & Rowe, 1971:184, fig. 96A.

*Material examined.*—Numerous specimens from the Yellow Sea, Xiemen (Amoy), Fujian Province and Zhanjiang, Guangdong Province.

*Remarks.*—This is one of the most common molpadiid holothurians in China. It is

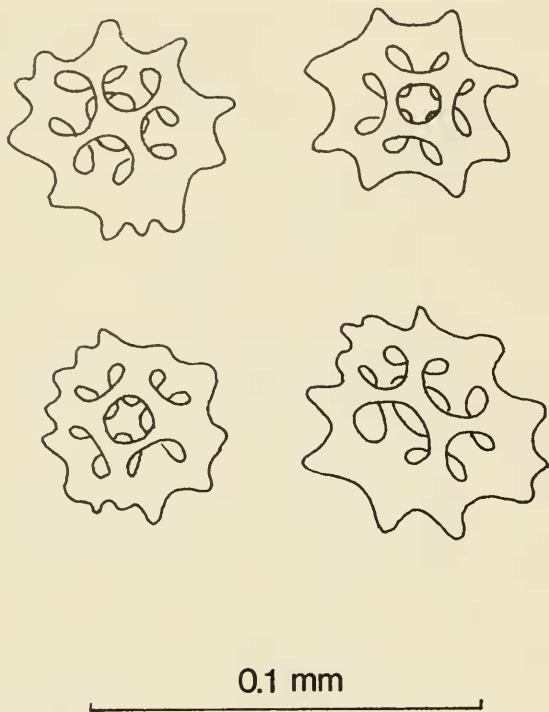


Fig. 8. *Paracaudina chilensis*, (Müller). Crossed cups from body wall of 30 mm specimen.

particularly abundant in the Yellow Sea, but in Southern China it seems to be uncommon, being known only from Xiemen (Amoy), Fujian Province and Zhanjiang, Guangdong Province. The animals live buried in sandy mud near lowtide mark, with the body directed downwards, and the posterior end at the surface of the substrate, for purposes of respiration. Color in life is white, often with a slight purplish tinge. Ossicles of a small specimen of 30 mm total length are illustrated here (Fig. 8) for comparison with those of *P. delicata*, n. sp.

*Distribution.*—Widespread in the circum-Pacific, known from Australia, Japan, California, Florida, Chile and New Zealand, in depths of 9–990 m (Pawson 1970). In China, it is known to range from Dalian, Liaodong Peninsula to Zhanjiang, Leizhou Peninsula, in littoral and sublittoral depths.

Genus *Acaudina* H. L. Clark, 1907

See Heding, 1931:284; H. L. Clark, 1946: 445.

*Diagnosis.*—Tentacles with only one pair of lateral digits. Tail practically absent, in-

conspicuous. Ossicles smooth or spinose thick plates, often doughnut-shaped with one or more perforations. Ossicles usually absent from body wall, but often found close to posterior end of body.

Key to species of *Acaudina*  
known from China

1. Ossicles more or less scarce, sometimes wanting, sometimes present only at posterior of body; in form of small oval bodies with one or sometimes a few holes; also more or less irregular perforated plates or dumbbell-shaped bodies or spinose thick plates may occur .....  
..... *molpadioides* (Semper, 1868)
- Ossicles more or less numerous, in form of small oval plates with three or four holes, a few doughnut-shaped bodies, and short, irregularly branched particles with broad blunt branches .....  
..... *leucoprocta* (H. L. Clark, 1938)

*Acaudina molpadioides* (Semper)

*Haplodactyla molpadioides* Semper, 1868: 41, pls. 9, 10, figs. 2a, 4, 5, 9; pl. 13, fig. 3.

*Acaudina molpadioides.*—H. L. Clark, 1946: 445.—Chang & Liao, 1964:46.—A. M. Clark & Rowe, 1971:184, fig. 96b, pl. 31, fig. 12.—A. M. Clark, 1982:489, 495.—Liao, 1984:250, textfig. 1.

*Material examined.*—695 specimens, collected at many localities ranging from the Gulf of Tonkin and Hainan Island northward to Qingdao, Shandong Province.

*Remarks.*—This is one of the most common and most variable holothurians in China, but it has not yet been reported from the Xisha Islands and Liaoning Province. After studying the rich material, we agree with Sluiter (1912) that *A. molpadioides* is a single highly variable species. We regard *A. delicata* (H. L. Clark) as a synonym of *A.*

*molpadioides*; the plates of *A. delicata* with serrated edges on perforations are found only in young animals, and they disappear as the animals grow.

*Distribution*.—Widely distributed in the Indo-Malayan region in 0–330 m.

*Acaudina leucoprocta* (H. L. Clark)

*Aphelodactyla leucoprocta* H. L. Clark, 1938: 543, fig. 60.

*Acaudina leucoprocta*.—H. L. Clark, 1946: 446.—A. M. Clark & Rowe, 1971:184.—Liao, 1984:252, textfigs. 2–3.

*Aphelodactyla irania* Heding, 1940:124, fig. 7.

*Acaudina irania*.—A. M. Clark & Rowe, 1971:184.

*Material examined*.—112 specimens from the Gulf of Tonkin to the East China Sea.

*Remarks*.—The occurrence of this big caudinid holothurian in large numbers on the southern coast of China is of great interest. It was originally described from three specimens collected near Broome, North-western Australia. The present material ranges from 20 to 270 mm in length. The smaller specimens conform to the description of *A. irania* (Heding) in all characteristics; we believe that *A. irania* as characterized by Heding merely represents young stages of *A. leucoprocta*.

In the body wall of smaller individuals the ossicles are almost all small, plump ring- or doughnut-shaped bodies, while in full-grown specimens they become small oval plates with 3 or 4 holes. In the Chinese specimens the ossicles seem to be more numerous than in Australian specimens. The color is typically dark purple or purplish brown, with the area around the anus light gray.

This is one of the most common large holothurians in China, and it is particularly abundant in the vicinity of Zhoushan Archipelago, Zhejiang Province, where it is used for beche-de-mer, and it is marketed at Shanghai as “sweet fish.”

*Distribution*.—Western Australia, Iran

and China (ranging from the Gulf of Tonkin to the East China Sea), in depths of 15–122 m.

### Literature Cited

- Augustin, E. 1908. Über Japanische Seewalzen.—Abhandlungen der K. Bayer Akademie der Wissenschaften II, Supplement i:1–44.
- Chang, F. Y. 1934. Report on the holothurians collected from the coast of China.—Contributions from the Institute of Zoology, National Academy of Peiping 2(1):1–52.
- , & Y. Liao. 1964. Echinodermata. In P. C. Wu and L. J. Cheng, eds., Illustrated fauna of China. Science Press, Beijing, 142 pp.
- Cherbonnier, G., & J. P. Féral. 1981. Echinodermes: Holothuries. Résultats des Campagnes Musorstom. I—Philippines (18–28 Mars 1976).—Mémoires ORSTOM 91(17):357–412.
- Clark, A. M. 1982. Echinoderms of Hong Kong. Pp. 485–501 in B. S. Morton and C. K. Tseng, eds., The marine flora and fauna of Hong Kong and Southern China. Hong Kong University Press, Hong Kong, 350 pp.
- , & F. W. E. Rowe. 1971. Monograph of shallow-water Indo-West Pacific echinoderms. British Museum (Natural History), London, 238 pp.
- Clark, H. L. 1907. The apodous holothurians.—Smithsonian Contributions to Knowledge 35:1–206.
- . 1935. The holothurian genus *Caudina*.—Annals and Magazine of Natural History, Series 10(15):267–284.
- . 1938. Echinoderms from Australia.—Memoirs of the Museum of Comparative Zoology at Harvard College 55:1–596.
- . 1946. The echinoderm fauna of Australia.—Carnegie Institution of Washington Publication 566:1–576.
- Deichmann, E. 1938. New holothurians from the western coast of North America and some remarks on the genus *Caudina*.—Proceedings of the New England Zoological Club 16:103–115.
- . 1940. Report on the holothurians collected by the Harvard-Havana Expeditions, 1938 and 1939, with a revision of the Molpadonia of the Atlantic Ocean.—Memorias Sociedad Cubana de Historia Natural “Felipe Poey” Havana 14(3): 183–240.
- Haeckel, E. H. 1896. Systematische Phylogenie der Wirbellosen Thiere (Invertebrata). Zweiter Theil des Entwurfs einer systematischen Stammesgeschichte. (Echinodermata pp. 348–504). Reimer, Berlin, 720 pp.
- Heding, S. G. 1931. On the classification of the molpadids.—Videnskabelige Meddelelser fra Dansk

- naturhistorisk Forening Kjobenhavn 92:275–284.
- . 1932. *Paracaudina* nom. nov., a correction together with some remarks concerning the supposed fossil holothurian *Pseudocaudina brachyura* Broili. — Videnskabelige Meddelelser fra Dansk naturhistorisk Forening Kjobenhavn 92: 455–456.
- . 1940. The holothurians of the Iranian Gulf. Pp. 113–137 in Danish scientific investigations in Iran, Part II. Ejnar Munksgaard, Copenhagen, 238 pp.
- Hozawa, S. 1928. On the changes occurring with advancing age in the calcareous deposits of *Caudina chilensis* (J. Muller). — Science Reports of the Tohoku Imperial University, Fourth Series, Biology, Sendai, Japan 3(3):361–378.
- Liao, Y. 1984. Notes on the genus *Acaudina* Clark, 1907 (Echinodermata: Holothuroidea) of China. — *Studia Marina Sinica* 23:249–255. (In Chinese with English summary.)
- Marenzeller, E. von. 1877. Die Coelenteraten, Echinodermen und Wurmer der K.K. Österreichisch-Ungarischen Nordpol-Expedition. Denkschriften der Mathematisch-Naturwissenschaftlichen Classe der Kaiserlichen Akademie der Wissenschaften 35:1–42.
- . 1881. Neue Holothurien von Japan und China. — *Verhandlungen der zoologisch-botanischen Gesellschaft in Wien* 31:121–140.
- Mitsukuri, K. 1912. Studies on actinopodous Holothuroidea. — *Journal of the College of Science, Imperial University of Tokyo* 29(2):1–284.
- Mortensen, T. 1927. Handbook of the echinoderms of the British Isles. Oxford University Press, London, 471 pp.
- Müller, J. 1850. Anatomische Studien über die Echinodermen. — *Archiv für Anatomie, Physiologie und wissenschaftliche Medizin* 1850:129–155.
- Ohshima, H. 1915. Report on the holothurians collected by the United States Steamer *Albatross* in the northwestern Pacific during the summer of 1906. — *Proceedings of the United States National Museum* 48:213–291.
- Pawson, D. L. 1963. The holothurian fauna of Cook Strait, New Zealand. — *Zoological Publications of Victoria University College* 36:1–38.
- . 1970. The marine fauna of New Zealand: sea cucumbers (Echinodermata: Holothuroidea). — *Memoirs of the New Zealand Oceanographic Institute* 52:1–69.
- . 1977. Molpadiid sea cucumbers (Echinodermata: Holothuroidea) of the southern Atlantic, Pacific and Indian Oceans. — *Biology of the Antarctic Seas VI*. — *Antarctic Research Series* 26:97–123.
- . 1982. Holothuroidea. Pp. 791–818 in S. P. Parker, ed., *Synopsis and classification of living organisms*. Vol. 2. McGraw-Hill, New York, 1232 pp.
- Risso, A. 1826. Histoire Naturelle des principales productions de l'Europe méridionale et particulièrement des celles des environs de Nice et des Alpes maritimes 5:289–293. F.-G. Levrault, Paris.
- Semper, C. 1868. Holothurien. Reisen im Archipel der Philippinen 2, Wissenschaftliche Resultate. Weisbaden, Wilhelm Engelmann, Leipzig, x + 288 pp.
- Sluiter, C. P. 1912. Die Gattung *Aphelodactyla* Lyman Clark (*Haplodactyla* Semper). — *Zoologische Jahrbücher*. Jena. Supplement 15(1):409–422.
- Stimpson, W. 1853. Synopsis of the marine Invertebrata of the Grand Manan. — *Smithsonian Contributions to Knowledge* 5:6–17.
- Théel, H. 1886. Report on the Holothuroidea. 2. — Report on the Scientific Results of the Voyage of the *Challenger* 1873–1876, *Zoology* 4(39):1–290.
- Yang, P. F. 1937. Report on the holothurians from the Fukien coast. — *Amoy Marine Biological Bulletin* 2(1–2):1–46.

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